PHOTOELECTRIC CONVERSION DEVICE AND METHOD OF MANUFACTURING PHOTOELECTRIC CONVERSION DEVICE

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a photoelectric conversion device and a method of manufacturing the photoelectric conversion device.

Description of the Related Art

In a photoelectric conversion device for detecting light information by a photoelectric conversion element, it is important to suppress a dark current which flows into the photoelectric conversion element in order to reduce a noise component which is superimposed to signal charges.

Japanese Patent Application Laid-Open No. 2002-217397 proposes a method whereby in order to reduce a dark current which flows into a photodiode as a photoelectric conversion element, a negative voltage is applied to a gate electrode of a transfer transistor during a charge accumulation period in the photoelectric conversion element. According to such the method, since a channel of hole is formed in an interface between an oxide film and a semiconductor substrate under the gate electrode of the transfer transistor serving as a source of the dark current, the generation of the dark current can be suppressed. On the other hand, according to the method disclosed in Japanese Patent Application Laid-Open No. 2002-217397, since a potential difference between the gate electrode of the transfer transistor and a floating diffusion region is large, there is a risk that in association with a deterioration in a gate insulating film of the transfer transistor, a reliability to insulating performance of the relevant portion decreases remarkably.

Japanese Patent No. 5016941 proposes a method whereby a negative voltage is applied to a gate electrode of a transfer transistor during a charge accumulation period in a photoelectric conversion element and a voltage of a floating diffusion region is set to a value lower than a power supply voltage. According to this method, since an electric field which is applied between the gate electrode of the transfer transistor and the floating diffusion region is reduced during the charge accumulation period, a deterioration in a gate insulating film in the relevant portion can be suppressed.

However, according to the method disclosed in Japanese Patent No. 5016941, by setting the voltage of the floating diffusion region to the value lower than the power supply voltage, a ratio at which charges overflowed from a photodiode during the charge accumulation period leak into an adjacent pixel is larger than a ratio at which such charges are moved to the floating diffusion region. Thus, there is a case where leakage characteristics into the adjacent pixel deteriorate.

SUMMARY OF THE INVENTION

It is an aspect of the present invention to provide a photoelectric conversion device which can realize both of an improvement of a reliability of a gate insulating film of a transfer transistor and a suppression of a leakage into an adjacent pixel and a method of manufacturing the photoelectric conversion device.

According to an aspect of the present invention, there is provided a photoelectric conversion device including a pixel including a transfer transistor transferring signal charges generated in a photoelectric conversion portion from a charge accumulation region to a floating diffusion region, and a peripheral transistor forming a peripheral circuit for controlling a read-out operation of a pixel signal based on the signal charges from the pixel, wherein a gate electrode of the transfer transistor and the floating diffusion region are separated from each other by a first distance in a plan view, and a gate electrode and a drain region of the peripheral transistor are separated from each other by a second distance smaller than the first distance in a plan view.

According to another aspect of the present invention, there is provided a method of manufacturing a photoelectric conversion device including a pixel including a transfer transistor transferring signal charges generated in a photoelectric conversion portion from a charge accumulation region to a floating diffusion region, and a peripheral transistor forming a peripheral circuit for controlling a read-out operation of a pixel signal based on the signal charges from the pixel, including forming a gate electrode of the transfer transistor and a gate electrode of the floating diffusion region over a semiconductor substrate, forming the floating diffusion region in the semiconductor substrate so as to be separated from the gate electrode of the transfer transistor by a first distance in a plan view, and forming a drain region of the peripheral transistor in the semiconductor substrate so as to be separated from the gate electrode of the peripheral transistor by a second distance smaller than the first distance in a plan view.

Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-sectional view illustrating a structure of a photoelectric conversion device according to a first embodiment of the present invention.

FIGS. **2**A, **2**B, **2**C, **2**D, **2**E, **2**F, **2**G and **2**H are cross-sectional views illustrating a method of manufacturing the photoelectric conversion device according to the first embodiment of the present invention.

FIGS. **3**A, **3**B and **3**C are cross-sectional views illustrating a method of manufacturing a photoelectric conversion device according to a second embodiment of the present invention.

FIG. **4** is a cross-sectional view illustrating a structure of a photoelectric conversion device according to a third embodiment of the present invention.

FIGS. **5**A and **5**B are cross-sectional views illustrating a method of manufacturing the photoelectric conversion device according to the third embodiment of the present invention.

DESCRIPTION OF THE EMBODIMENTS

Preferred embodiments of the present invention will now be described in detail in accordance with the accompanying drawings.

First Embodiment

A photoelectric conversion device and a method of manufacturing the same according to a first embodiment of the present invention will be described with reference to FIGS. **1** to **2**H.

FIG. **1** is a schematic cross-sectional view illustrating a structure of the photoelectric conversion device according to the present embodiment. FIGS. **2**A to **2**H are cross-sectional